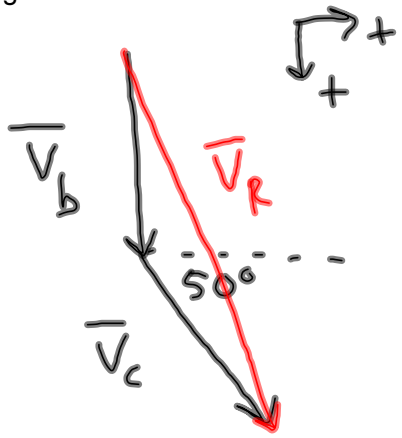
River Problems:

- Vector problem because boat and current both have velocity.

- We can find net velocity, displacement in x- or y-directions and time.

As a boat travels 3.33 m/s due south, there is a current pushing 2.22 m/s at 50 degrees south of east. What is the resultant speed and direction of the boat?



$V_{bx} = 0$ m/s

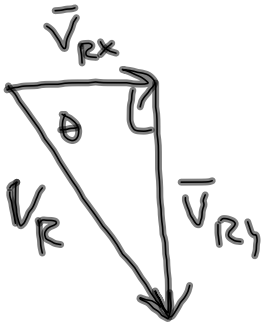
$V_{cx} = +1.43$ m/s

$V_{Rx} = 1.43$ m/s

$V_{by} = +3.33$ m/s

$+V_{cy} = +1.70$ m/s

$V_{Ry} = 5.03$ m/s



$V_R = 5.23$ m/s

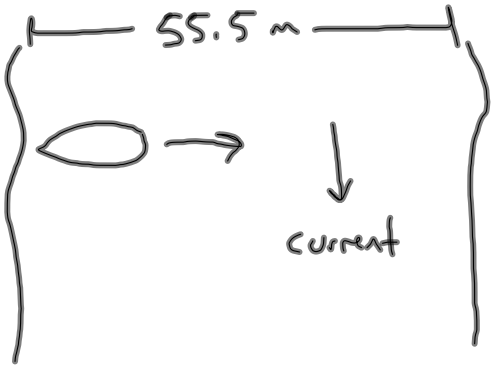
$\theta = 74.2°$

S of E

$\bar{V}_R = 5.23$ m/s @ 74.2° S of E

River and Ramp Problems 3.27.12 Honors Physics

A boat travels due east at 8.88 m/s. There is also a 2.2 m/s current south acting on the boat. The river is 55.5 m wide.
a) How long will it take the boat to cross the river?
b) How far downstream will it end up from where it started?



a) $V_x = \frac{\Delta x}{\Delta t}$

$\Delta t = \frac{\Delta x}{V_x}$

$= \frac{55.5\ m}{8.88\ m/s}$

$= 6.25\ s$

b) $V_y = \frac{\Delta y}{\Delta t}$

$\Delta y = V_y \Delta t$

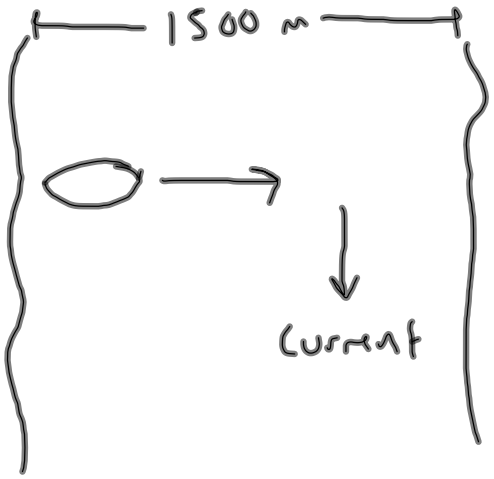
$= (2.2\ m/s)(6.25\ s)$

$= 13.8\ m$

* Another way to solve would be to use displacement and velocity triangles.

River and Ramp Problems 3.27.12 Honors Physics

A boat travels due east at 14 m/s. There is also a 8.9 m/s current south acting on the boat. The river is 1500 m wide.
a) How long will it take the boat to cross the river?
b) How far downstream will it end up from where it started?



a) $V_x = \frac{\Delta x}{\Delta t}$

$\Delta t = \frac{\Delta x}{V_x}$

$= \frac{1500\ m}{14\ m/s}$

$= 107\ s$

b) $V_y = \frac{\Delta y}{\Delta t}$

$\Delta y = V_y \Delta t$

$= (8.9\ m/s)(107\ s)$

$= 953\ m$

Ramps:

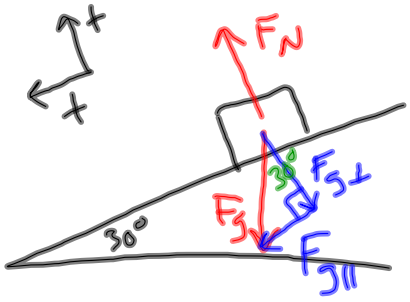
- Use Newton's 2nd Law to find forces, acceleration, and (if using friction equation) coefficient of friction.

- Use parallel and perpendicular directions

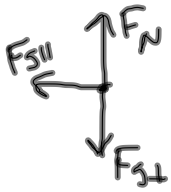
- Mutually orthogonal → set of axes that are perpendicular to each other

River and Ramp Problems 3.27.12 Honors Physics

A 20 kg box is on a frictionless ramp that is angled 30 degrees above the horizontal. What is the box's acceleration as it moves down the ramp?



FBD:



$$\sin(30°) = \frac{F_{g\parallel}}{F_g} \qquad \cos(30°) = \frac{F_{g\perp}}{F_g}$$

$$F_{g\parallel} = F_g \sin(30°) \qquad F_{g\perp} = F_g \cos(30°)$$

$$\sum F_{\parallel} = m a_{\parallel}$$

$$+F_{g\parallel} = m a_{\parallel}$$

$$a_{\parallel} = \frac{F_{g\parallel}}{m} \qquad F_{g\parallel} = F_g \sin(30°)$$

$$= m a_g \sin(30°)$$

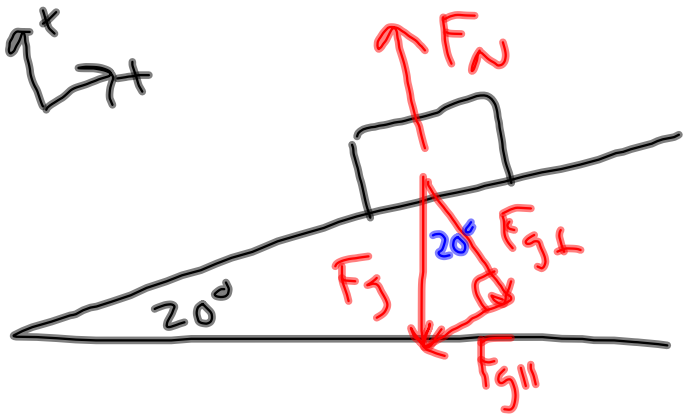
$$= \frac{\cancel{m} a_g \sin(30°)}{\cancel{m}}$$

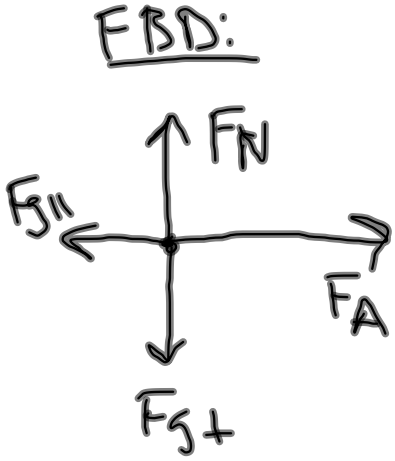
$$= a_g \sin(30°)$$

$$= (9.8\ m/s^2) \sin(30°)$$

$$= 4.9\ m/s^2$$

A box of mass 5 kg is on a frictionless ramp that makes an angle of 20 degrees above the horizontal. The box is pushed up the ramp with a force of 80 N. What is the acceleration of the box as it moves up the ramp?





$$\sum F_{\parallel} = ma_{\parallel}$$

$$F_A - F_{g\parallel} = ma_{\parallel}$$

$$a_{\parallel} = \frac{F_A - F_{g\parallel}}{m}$$

$$= \frac{80\,N - 16.8\,N}{5\,kg}$$

$$= 12.65\ m/s^2$$

$$F_{g\parallel} = F_g \sin(20°)$$

$$= mg \sin(20°)$$

$$= 16.8\,N$$

A 5.5 kg suitcase is at rest on a ramp that is angled 22.0 degrees above the horizontal. What is the coefficient of friction between the suitcase and the surface of the ramp?